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Production of IHPF components having a flange

- 5 The invention relates to a method of producing a hollow profile having at least one flange by means of internal high pressure forming.

10 Conventional hollow profiles with a flange are generally produced by extrusion. In particular in automobile construction, the flange is required in order to fasten the hollow profile, produced by extrusion for example, to further vehicle body parts.

- 15 DE 10130794 A1, for example, has disclosed an extruded profile which has a flange and is subsequently subjected to internal high pressure forming, the course and the direction of the flange over the length of the structural part not being established in a dimensionally accurate  
20 manner until during the deforming according to the internal high pressure process.

However, an extruded hollow profile having a flange generally has the disadvantage that the hollow profile  
25 can only be bent and/or widened with difficulty. The reason for this is that the connecting point of the flange on the hollow profile acts like a tension rod against the forming force. In addition, on account of the accumulation of material at this connecting point, the  
30 flange cannot expand sufficiently and therefore the hollow profile cannot be formed in a controlled manner.

It is known from DE 19905365 A1 to produce a hollow profile having a flange by roll forming from a sheet-  
35 metal blank, the hollow profile then subsequently being subjected to internal high pressure forming. In this

case, the flange is established beforehand in such a way that its position and dimensions are not formed until during the internal high pressure forming. However, such a method is complicated in its implementation inasmuch as  
5 that portion of the flange on the initial hollow profile which is to be deformed during the internal high pressure forming has to be accurately established or calculated as a function of the holding-down force for the flange on the one hand and the internal high pressure to be applied  
10 on the other hand. In addition, the hollow profile shown in this publication has the disadvantage that the initial hollow profile has sharp edges, which, on account of the pronounced hardening during the profile production process, possibly remain behind as visible residual edges  
15 or undulations on the final finished hollow profile produced by the IHPF process. The bending-back or stretching of such profile edges hardened to a pronounced extent cannot be completely taken into account in the IHPF process.

20 Starting therefrom, the object of the present invention is to provide a method of producing a hollow profile by means of which a hollow profile having at least one flange can be produced in a simple and controlled manner.

25 This object is achieved by a method having the features according to patent claim 1.

The method is distinguished by the fact that an initial  
30 hollow profile consists of a single sheet, at least one flange being formed in the longitudinal direction of the initial hollow profile likewise by corresponding folding or roll forming of the sheet. The sheet can be produced in particular from a sheet-metal blank and/or a roll-

formed sheet unwound from the coil.

Then, in order to form a closed initial hollow profile, the joint location of the sheet is welded and the closed  
5 initial hollow profile is inserted into an internal high pressure forming (IHPF) tool. During the insertion, the at least one flange is positioned in a corresponding cavity in the IHPF tool and is clamped in place with a defined holding-down force during the internal high  
10 pressure forming.

According to the invention, the inner contour of the IHPF tool, on the one hand, and the holding-down force to be applied on the flange during the internal high pressure  
15 forming, on the other hand, are selected in such a way that the position of the flange always remains unchanged relative to the finished hollow profile then formed.

In this case, it is possible according to the invention  
20 to establish the holding-down force in such an order of magnitude that a subsequent flow of material into the finished hollow profile on no account occurs during the internal high pressure forming.

25 Under certain circumstances, however, it may also be desired for such a subsequent flow of material from the flange into the finished hollow profile to be allowed, so that a corresponding holding-down force is to be selected.

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According to the invention, the flange can be produced in different ways during the folding or roll forming of the sheet.

Thus it is possible, on the one hand, for the flange to be formed by doubling of the material of the sheet during the folding or roll forming, that is to say the sheet is folded over or roll-formed, with the flange being formed.

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Another possibility consists in the fact that the sheet is folded or roll-formed in such a way that the two ends of the sheet form an overlapping joint for forming the flange.

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However, it is also possible for the sheet to be folded or roll-formed at one end, with the flange being formed, and for the other end, during the folding or roll-forming, to be formed in such a way that it abuts against the transition region between the flange and the initial hollow profile.

In order to form a closed initial hollow profile, the sheet is welded together in the region of its free ends. Since these free ends can lie in the region of the flange or outside this region, welding is carried out there in each case.

If a subsequent flow of material from the flange is desired during the internal high pressure forming, the weld is at any rate located outside the flange region in the initial hollow profile.

Hollow profiles produced by the method according to the invention are suitable, for example, for use in body construction as roof frames, side sills, transverse members or longitudinal and transverse members in the body floor assembly, in which case the adjacent body components can then be attached to the flange by

conventional joining processes, such as resistance spot welding for example.

Further advantages and features of the method according to the invention follow from the description below with reference to the attached drawings, in which:

- fig. 1 schematically shows an IHPF tool with a flange clamped in place;
- figs 2a and 2b show an initial hollow profile with different positions of the weld;
- fig. 3 shows a further initial hollow profile with a single flange; and
- figs 4a and 4b each show an initial hollow profile with a weld outside the flange region.
- Shown schematically in fig. 1 is an IHPF tool 1 which consists of a top part 2 and a bottom part 3. Both parts 2 and 3 form a cavity 4, which corresponds to the contour of the final finished hollow profile.
- A sheet-metal blank formed into an initial hollow profile 5 is inserted into this cavity 4. The initial hollow profile 5 has a flange 6, which is clamped in place in a corresponding section 7 of the cavity 4.
- The clamping in place can be effected with such a holding-down force that either no subsequent flow of material can take place from the region of the flange 6 into the finished hollow profile or such a subsequent flow of material is allowed.

By way of example, figs 2a and 2b show an initial hollow profile 5 in which a flange 8 is formed by an overlapping joint of the free ends of the sheet. The flange 8 can  
5 then be welded either by a weld 9 being provided in the joint region of the flange 8 (fig. 2a) or by a weld 9 being provided in the course of the flange 8 transversely to the latter (fig. 2b).

10 Furthermore, by way of example, fig. 3 shows an initial hollow profile 5 in which the flange 10 is formed by a free end of the sheet being appropriately bent over and by the other free end being welded on in the transition region between the flange 10 and the initial hollow  
15 profile 5.

A further possibility consists in forming a flange 11 of the initial hollow profile 5 in such a way that the sheet is folded over and thus overlaps in the region provided  
20 for the flange 11. This is shown by way of example in fig. 4a for a single flange 11 and in fig. 4b for two flanges 11. In both cases the weld 9 is located outside the flange in the region of the initial hollow profile 5. Such an initial hollow profile with a weld 9 established  
25 outside the flange region is preferably to be used when a subsequent flow of material from the region of the flange 11 during the internal high pressure forming is to be permitted.